INTRODUCTION TO PHYSICS

Name of Scientists	MASTER WORK
(1) IBN-UL-HAITHAM	Kitab-ul-Manazir (Book) gave laws of reflection, constructed pinhole camera.
(2) AL-BERUNI	Kitab-al-Qanoon-al-Masoodi (Book)
(3) ABUS-SALAM	GUT (Grand unification Theory)
(4) ABDUL QADIR	Atomic physics (Nuclear physics)
(5) Al-Khwarzmi	Aljabar-ul-Muqabla (Book) (founder of algebra)

* Laser is a field of Atomic physics.

MEASUMENTS

BASIC UNITS:

Units	Used for.
1. Meter (m)	Length, distance, height (L)
2. Kilogram (kg)	mass (m)
3. Second (s)	time (t)
4- Ampere (A)	current (I)
5- Kelvin (K)	temperature (T)
6- Mole (mol)	amount of substance (n)
7- Candela (cd)	luminous intensity (Iv)

DERIVED UNITS:

QUANTITY	Unit	Symbol
1. Angle	Radians.	
2. Density (ρ)	K.gram / cubic meter	kg/m3
3. Speed (v)	meter / second	m/s
4. Velocity ($\vec{v}$)	meter / second	m/s
5. Acceleration (a)	meter / second square	m/sec^2
6. Area (A)	Sq. meter	m^2
7. Volume (V)	cubic meter	m3
8. Force (F), Weight (W), Centripetal force, Tension (T), (Fc)	Newton	N (kg.m/sec^2)
9. Normalitm (P)	k.gram / meter / second	kg.m/sec^2
10. Force of friction (F_s)	Newton	N
11. coefficient of friction (μ_s)	Ratio ----	Ratio
12. Torque (τ)	Newton . meter	N.m
13. Gravitation acceleration (g)	meter / second . second	m/sec^2
14. Gravitional constant (G)	Newton meter sq / sq. kilogram	Nm^2/kg^2
15. Work (W), Energy (E) amount of heat (Q)	Joule	J
16. Power (P)	Watt (or Joule/second)	Wor or J/sec
17. M. advantage (MA)	------	Ratio
18. Efficiency	----	%
19 Stress (σ)	Newton / meter . meter	N/m^2
20 Strain	----	ratio
21. Pressure (P)	Pascal (or Newton / meter . meter)	Pa or N/m^2 or atm

23. Temperature (T)	kelvin or celcius or Farhait	K, C° or F
Universal gas constant (R)	Joule / mole · kelvin	J/mol·k
24. Specific heat (c)	Joule/k·gram·kelvin	J/kg K
25. Latent heat of fusion	Joule/k·gram	J/kg
26. Latent heat of vaporization	Bule/k·gram.	J/kg
27. Coefficient of linear expansion (α)		
28. coefficient of volumetric expansion (β)	— 1/kelvin or 1/centigrate	1/K or 1/C°
30. Wavelength (λ)	meter (micro, milli)	m (μ, m)
31. frequency (ν) or (f)	Hertz or cycle/second	Hz or (cps)
32. time period (T)	Second	S
33. Refractive index (n)	- - - -	Ratio
34. focal length (f)	meter or centimeter	m or cm
35. linear magnification (M)	- - - -	Ratio
36. charge (C)	Coulombs	C
37. Current (I)	Ampere	A
38. resistance (R)	Ohm	Ω
39. Electric potential (PD) or electromotive force	Volts	V
40. capacitance (C)	Farad	F
50. power of lens (P)	Diopter	Dioptry
51. weight	Newton	Newton
52.		

PREFIXES (Power of Ten)

Symbol	Prefix	Sub multiple	Symbol	Prefix	multiple
d	Deci	10^{-1}	T	Tera	10^{12}
c	Centi	10^{-2}	G	Giga	10^{9}
m	milli	10^{-3}	M	mega	10^{6}
μ	Micro	10^{-6}	k	Kilo	10^{3}
n	Nano	10^{-9}	h	Hecto	10^{2}
p	Pico	10^{-12}	da	Deca	10^{1}

Some Conversions:

$1\,km = 1000\,m = 10^{3}\,m$

* $1\,mm = \frac{1}{1000}\,m = 10^{-3}\,m$
* $1\,g = \frac{1}{1000}\,kg = 10^{-3}\,kg$
* $1\,mg = 10^{-3}\,g$
* $60\,sec = 1\,min$
* $60\,min = 1\,hour = 3600\,second$

SCALAR & VECTOR

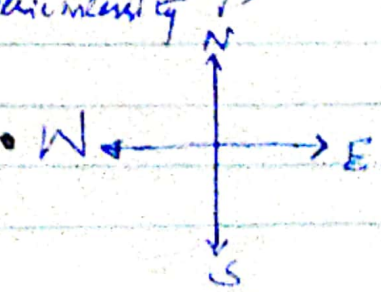
- magnitude + Unit ⟶ Scalar quantity

  e.g, G, distance, speed, Energy, time, length, ~~Force, weight, torque(τ), acceleration, stress, Electric intensity etc~~ temperature, work, volume, density, Area, Heat, charge, power etc

- magnitude + direction + unit ⟶ Vector quantity

  e.g ; g, displacement, velocity, momentum, Force, weight, torque, acceleration, stress, Electric intensity

- negative vector ⟹ $\vec{A}$ and $-\vec{A}$ (same magnitude & opposite direction)

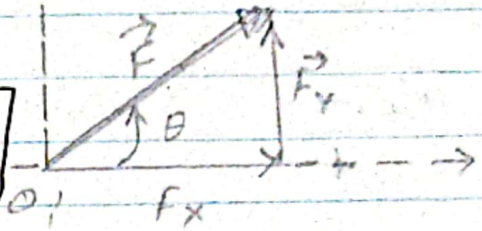


Resultant vector

- Null vector : $|\vec{A}| = 0$
- Resultant of a vector $\Rightarrow$ $R = \vec{A} + \vec{B}$
- Addition of vector $\longrightarrow$ Head to tail rule

- X-component or Horizontal component of vector $\Rightarrow$ $F_x = F\cos\theta$
- Y- " " Vertical component " " $\Rightarrow$ $F_y = F\sin\theta$

- Magnitude of vector $\vec{F}$: $F = \sqrt{F_x^2 + F_y^2}$
- Direction " " " $\vec{F}$; $\theta = \tan^{-1}\left(\frac{F_y}{F_x}\right)$



Imp ★ Angle b/w $\vec{F_x}$ and $\vec{F_y}$ is 90°

Some people have curly Brown hair tho purple back

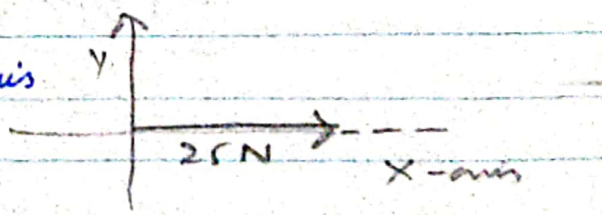
$\sin\theta = \frac{\text{Perp}}{\text{Hyp}}$

$\cos\theta = \frac{\text{Base}}{\text{Hyp}}$

$\tan\theta = \frac{\text{Perp.}}{\text{Base}}$

θ	45°	30°	60°	0°	90°
sinθ	$\frac{1}{\sqrt{2}} = 0.707$	$\frac{1}{2} = 0.5$	$\frac{\sqrt{3}}{2} = 0.866$	0	1
cosθ	$\frac{1}{\sqrt{2}} = 0.707$	$\frac{\sqrt{3}}{2} = 0.866$	$\frac{1}{2} = 0.5$	1	0
tanθ	1	$\frac{1}{\sqrt{3}} = 0.577$	$\sqrt{3} = 1.732$	0	∞

Imp ★ A force of 25N act along X-axis its Y-component is 0



KINEMATICS

- Speed(N) = $\frac{\text{distance (s)}}{\text{time (t)}}$
- Velocity(N) = $\frac{\text{displacement}}{\text{time (t)}}$

Imp • Velocity is speed in specified direction

- average time = $t = \frac{t_1 + t_2}{2}$
- Changen velocity = $\Delta V = V_f - V_i$

- Acceleration (a) = $\frac{\Delta V}{t} = \frac{V_f - V_i}{t}$

- deceleration = $(-)\frac{\Delta V}{t}$; velocity is decreasing

- 1st equ of motion ⟶ $V_f = V_i + at$
- 2nd eq " ⟶ $S = V_i t + \frac{1}{2} a t^2$
- 3rd " " ⟶ $2aS = V_f^2 - V_i^2$

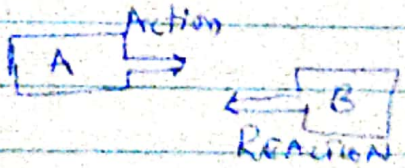
Note:-

- Whenever a body start from rest $V_i = 0$ and $a = +ve$
- Applying brake a body comes to rest $V_f = 0$ and $a = -ve$
- Whenever an object moves upward ; $g = -9.8\ m/s$
- " " " " downward ; $g = 9.8\ m/s$
- If a body moving with Uniform Velocity it has no acceleration i.e. $a = 0$
- A train moves with uniform velocity for one hour Its ~~always~~ average velocity and uniform velocity remains same in this hour.

FORCE & MOTION

~~Force~~

- Newton's 1st Law ⟶ Law of inertia
  inertia depends upon mass
- Newtons Second Law ⟶ $F \propto a \Rightarrow F = ma$
- Newton's third Law ⟶ $F_A = -F_B$

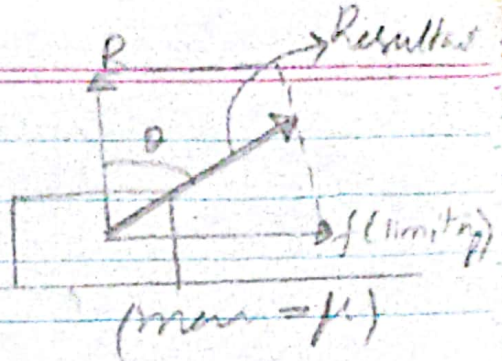


- Weight ⟶ $W = mg$
- mass ⟶ quantity of matter
- Momentum = Mass × Velocity ⇒ $P = mv$

• Isolated system → System having no external and opposing force

• Law of momentum

$$m_1u_1 + m_2u_2 = m_1v_1 + m_2v_2$$



• Coefficient of friction $\Rightarrow \mu = \frac{f(\text{limiting})}{R}$

• R = normal reaction $[R = mg]$

$(\tan\theta = \mu)$

• Rolling friction is much less than sliding friction

STATICS

• Static Equilibrium = at rest = a book on table

• Dynamic " = A paratrooper = moving with Uniform velocity

• Conditions of Equilibrium

1st Condition ; $\sum F_x = 0$ and $\sum F_y = 0$

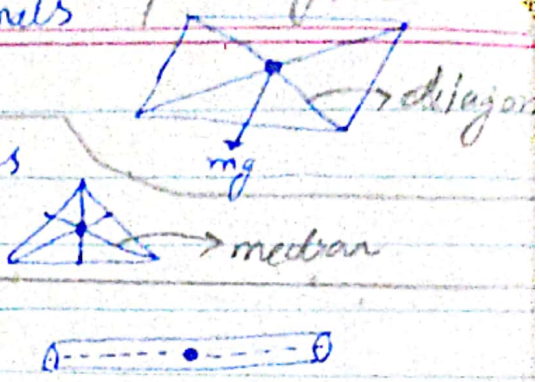
2nd Condion ; $\sum \tau = 0$ $(\tau = \text{taou})$

• Torque = Force × moment arm $\Rightarrow \tau = F \cdot d$

• Centre of gravity → point where whole weight of a body appears to act

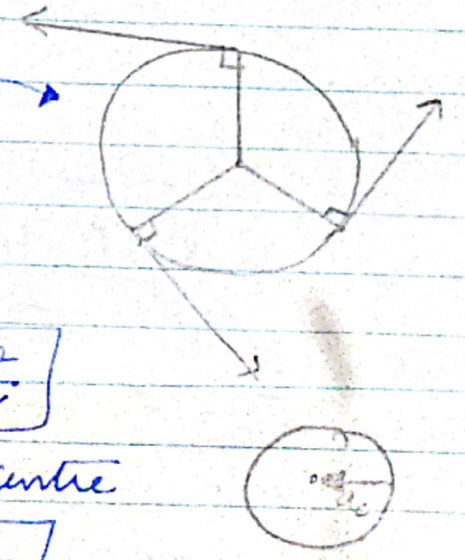
Name of body	Position of centre of gravity
1. Sphere	Centre of sphere
2. Uniform rod	centre of rod
3. Circular plate	Centre of plate
4.	

4. Square, rectangle ~~or parallelogram~~	Intersection of diagonals
5. Triangle	Intersection of medians
6. Cylinder	Mid point of axis



CIRCULAR MOTION AND GRAVITATION

- Uniform circular motion → motion in circular path with uniform velocity



- Centripetal acceleration

Magnitude ⇒ $\boxed{a_c = \frac{v^2}{r}}$

Direction = towards the centre

- Gravitational force = $\boxed{F = G\frac{m_1 m_2}{r^2}}$

Where G = Gravitational constant $= 6.67 \times 10^{-11}\ \frac{Nm^2}{kg^2}$

- mass of earth ⇒ $\boxed{M_e = \frac{g R_e^2}{R G}}$ R_e = Radius of earth $= 6.4 \times 10^6$ m

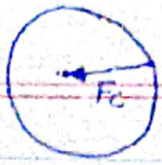
$M_e \cong 6 \times 10^{24}$ kg

- Variation of 'g' with altitude $\boxed{g \propto \frac{1}{r^2}}$

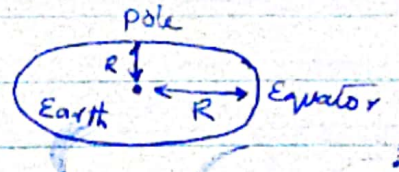
R (Distance b/w body and centre of earth)	g	N = mg
Decrease	increase	increase
increase.	decrease	decrease

• Centripetal force = $F_c = \frac{mv^2}{r}$

↳ centre seeking force



• Centrifugal force = $F_c = -\frac{mv^2}{r}$



• Weight of a body is greater at poles
• Weight of a body is less at Equator.

• Weight of a body in space $\Rightarrow W = 0 \quad \therefore g = 0$.

.. Note :-

• For circular motion; Tension in string = centripetal force

$T = F_c = \frac{mv^2}{r}$

WORK ENERGY & POWER

• Work done = $F \cdot S$ = Force × displacement

or $W = FS\cos\theta$

• Energy ⟶ ability to do work

• $K.E = \frac{1}{2}mv^2$ • $P.E = mgh$ • Power = $\frac{\text{Work}}{\text{time}} \Rightarrow P = \frac{W}{t}$

• 1 h.p = 746 watt

MACHINE

• Input = Effort × distance covered by effort

Input = P × S

• Output = Load × distance moved by load

Output = W × D

• % Efficiency = $\frac{\text{output}}{\text{input}} \times 100\%$

Mechanical Advantage = load/effort $\Rightarrow \boxed{M.A = \frac{W}{P}}$ = load

- For ideal machine
  output = input
  Efficiency = 100%
- M.A of lever $\Rightarrow \boxed{M.A = \frac{\text{effort arm}}{\text{load arm}}}$
- M.A of Inclined plane $\Rightarrow \boxed{M.A = \frac{l}{h} = \frac{1}{\sin\theta}}$
- M.A of screw $\Rightarrow \boxed{M.A = \frac{2\pi d}{h}}$ → diameter, → pitch
- M.A of wheel and axle $\Rightarrow \boxed{M.A = \frac{\text{Radius of wheel}}{\text{Radius of axle}}}$
- M.A of fixed pulley $\Rightarrow \boxed{M.A = 1}$
- M.A of movable pulley $\Rightarrow \boxed{M.A = 2}$

MATTER

- Stress = $\sigma = \frac{\text{Force}}{\text{Area}} = \boxed{\sigma = \frac{F}{A}}$ $(\sigma = ETA)$
- Linear strain = $\frac{\text{change in length}}{\text{original length}} \Rightarrow \boxed{\epsilon = \frac{\Delta L}{L}}$
- Volumetric strain = $\frac{\text{change in volume}}{\text{original volume}} \Rightarrow \boxed{\epsilon = \frac{\Delta V}{V}}$
- Hook's Law $\Rightarrow \boxed{\frac{\text{stress}}{\text{strain}} = \text{constant}}$; $\boxed{\text{stress} \propto \text{strain}}$
- Young's Modulus = $\frac{\text{stress}}{\text{Longitudinal strain}} \Rightarrow \boxed{Y = \frac{FL}{A\Delta L}}$

- Pressure = $\frac{\text{Force}}{\text{Area}}$ = $P = F/A$
- Pressure of liquid => $P = \rho h g$ > depth
  density
- At sea level $P_r = 100000$ Pa
- $1\ Pa = 1\ N/m^2$
- Barometer = instrument use to measure atmospheric pressure
- 1 atm = 760 mm Hg
- Archimedes principle
  - Apparent weight = Actual weight by object − Weight of liquid displaced
  - Buoyancy = weight of the fluid displaced

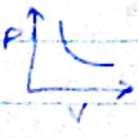
HEAT

- Heat ——> form of energy measure in Joule
- Conversion of °C into K ——> $T_K = T_C + 273$
- conversion of °C into °F ——> $T_F = 9/5\ (T_C + 32)$
- conversion of °F into °C ——> $T_C = 5/9\ (T_F - 32)$

merging

- $\frac{°C - 0}{100} = \frac{°F - 32}{180} = \frac{K - 273}{100}$
- Absolute zero = −273°C or 0K
- Linear thermal expansion ——> $\Delta L = \alpha L \Delta T$
  coefficient of linear expansion ——> $\alpha = \frac{\Delta L}{L \cdot \Delta T}$ — change in L / orig. L · ΔT
- Volumetric expansion ——> $\Delta V = \beta V \Delta T$
- Coefficient of volumetric exp ——> $\beta = \frac{\Delta V}{V \Delta T}$
- Relation Between β and α $\beta = 3\alpha$
- Real Expansion = Apparent expansion + Expansion of containing vessel

- Anomalous Expansion:
  When water is heated from 0°C to 4°C, it contracts
  When water is cooled from 4°C to 0°C, it expands
- Water has maximum density at 4°C
- Ice floats on the surface of water
- The amount of heat required to change of state called Latent Heat
- Boyle's Law:
  $P \propto \frac{1}{V}$ (T = constant) $\boxed{PV = \text{constant}}$



- Charle's Law:
  $V \propto T$ (P = constant) $\boxed{\frac{V}{T} = \text{constant}}$

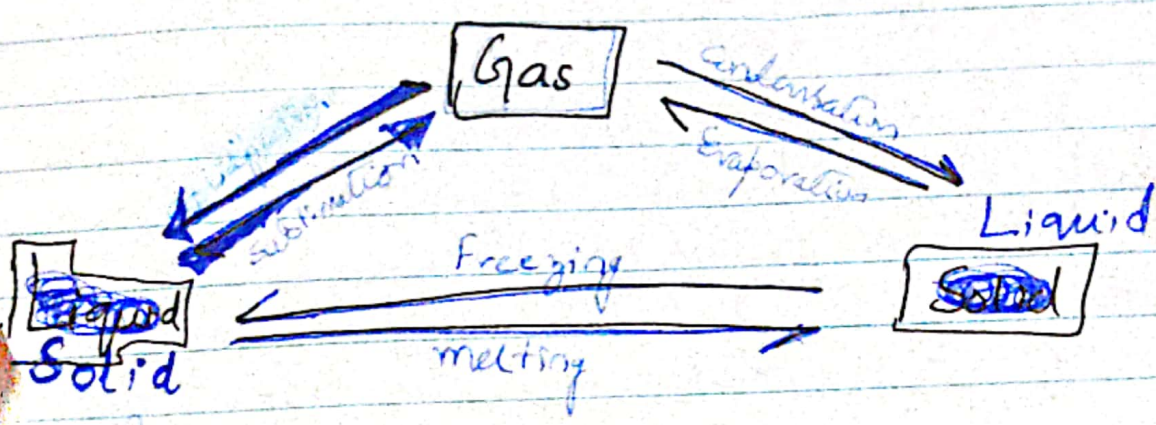
- Pressure Law:
  $P \propto T$ (V = constant) $\boxed{\frac{P}{T} = \text{constant}}$

- General gas equation
  $\boxed{PV = nRT}$ n = no of moles
  (R = Gas constant = 8.31 J/mole k)
- Heat capacity = $\frac{\text{amount of heat}}{\text{change in temp}} = \boxed{\frac{\Delta Q}{\Delta T}}$
- Specific heat capacity = $\boxed{c = \frac{\Delta Q}{m \Delta T}}$ → amount of heat; → change in temp; ↓ mass
- Laws of heat exchange:
  $\boxed{\text{Heat lost by hot body} = \text{Heat gained by cold body}}$
- Evaporation:
  Liquid ⟶ Vapour (Gas)
  (without boiling)
  - It is not effected by temp
  - It occurs at all temp
  - It is cooling process

- steam produces more severe burns than the hot water b/c of additional heat called Latent heat.

- Melting: Solid ⟶ Liquid
  e.g: Ice ⟶ Water

- Boiling: Water $\xrightarrow[100^{\circ}C]{\text{Boiling}}$ Gas



- Refrigeration:
  It is cooling device
  It consist of i) Evaporator ii) Compressor iii) Condenser
  Freon gas is used as refrigerant

WAVES AND SOUNDS

- Wave ⟶ transfer of energy through molecules
- Sound ⟶ form of energy

- Vibration or Oscillation ⟶ To and fro motion

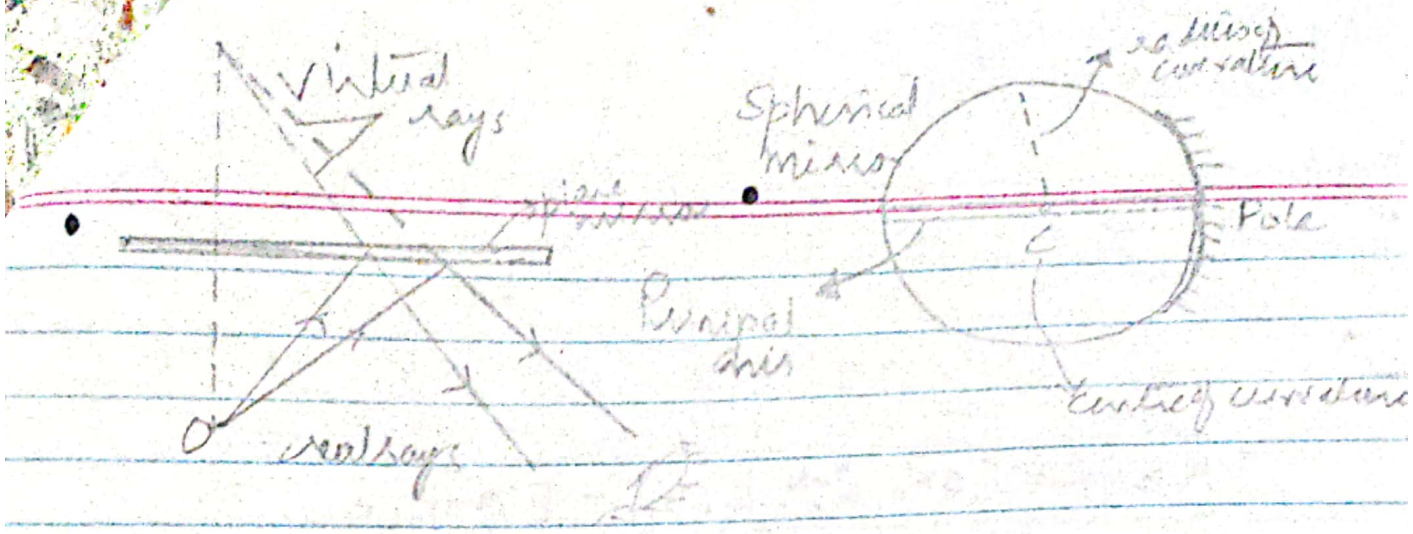
- SIMPLE HARMONIC MOTION (S.H.M)
  condition $a \propto -x$
- Time period of attached mass spring = $T = 2\pi\sqrt{m/k}$
  k = constant
- Time period of simple pendulum = $T = 2\pi\sqrt{l/g}$
- Time period of second's pendulum = $T = 2$ sec
  frequency = $f = 0.5$ Hz.

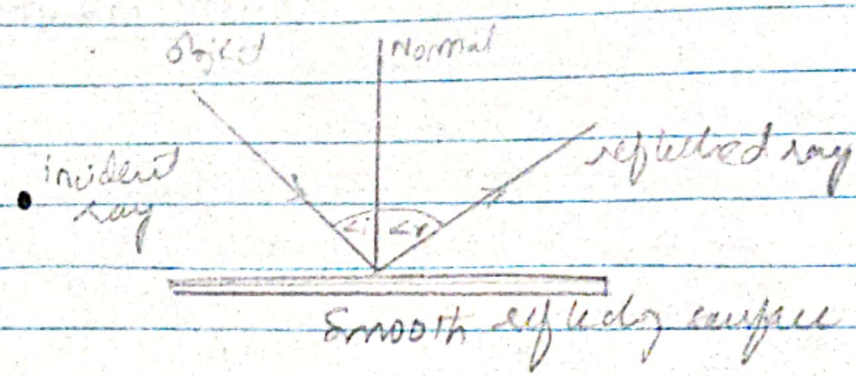
- Relation b/w Time period and frequency: $T = \frac{1}{f}$

- Sound waves travel fastest in iron.
- Velocity of the wave $\Rightarrow$ $V = f\lambda$
- Frequency of the wave $\Rightarrow$ $f = V/\lambda$
- Velocity of sound in space (Vacuum) = 0 m/sec
- Velocity of sound in air = 322 m/s
- Velocity of light in air (3×10^8 m/s) is greater than velocity of sound in air (332 m/s)
- Sound waves not travel in vacuum
- Soldiers are instructed to break their steps while crossing a suspended bridge due to RESONANCE
- The maximum beat frequency that a human ear can detect is 7 beats per second
- Ultrasonic waves → frequency > 20,000 Hz
- Audible frequence → 20 Hz to 20,000 Hz
- Infrasonic waves → frequency < 20 Hz
- Ultrasonic waves → longitudinal waves.
- or Sound waves
- Minimum distance for echo → 17 m
- Transverse wave can travel in Vacuum
  - → Radiowaves, micro waves.

PROPAGATION AND REFLECTION OF LIGHT

- Light → form of energy
- Ray (→)
- Beam (Stream of rays)



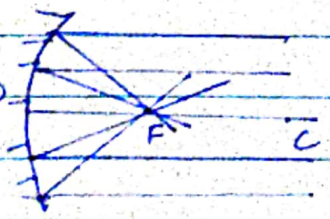


- angle of incidence $= \angle i$; angle of reflection $= \angle r$
- In regular reflection ; $\angle i = \angle r$
- In irregular reflection ; $\angle i \neq \angle r$

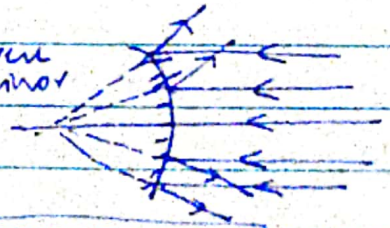
- Magnification $=$ $\frac{\text{size of image}}{\text{size of object}} \Rightarrow \boxed{M = \frac{h_o}{h_i}}$

- Linear magnification $=$ $\frac{\text{image distance}}{\text{object distance}} \Rightarrow \boxed{M = \frac{v}{p}}$

- Concave mirror



- Convex mirror



- Mirror formula $\Rightarrow \boxed{\frac{1}{f} = \frac{1}{v} + \frac{1}{p}}$

- 'f' is positive for concave mirror and negative for convex mirror

• 'v' is positive for real image and negative for virtual image.

• Real image ——> can be brought on screen
• Virtual image ——> cannot be brought on screen

REFRACTION OF LIGHT & OPTICAL INSTRUMENT

• Refractive index

$\Rightarrow n = \frac{\sin \angle i}{\sin \angle r}$; it is constant for any medium

Snell's Law.

Refractive Index = $\frac{\text{speed of light in air } (3 \times 10^8 \text{ m/s})}{\text{speed of light in medium}}$

Note

• From denser medium (water) to rare medium (air)

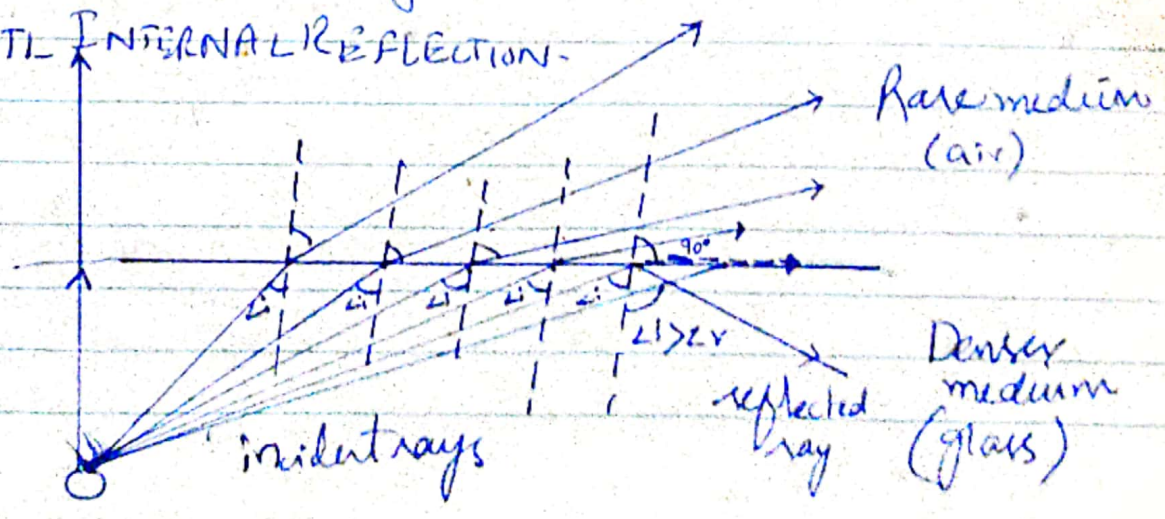
$\angle r > \angle i$

• From rare medium (air) to denser medium (water)

$\angle i > \angle r$

Refractive index of water = 1.33
" " glass = 1.52
" " diamond = 2.42
" " Ruby = 1.5

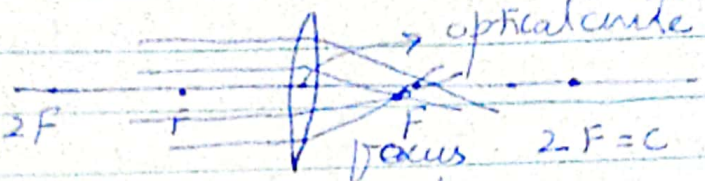
• TOTAL INTERNAL REFLECTION.



• For total internal reflection the angle must be greater than the CRITICAL angle. ($\angle 90°$)

• Lens :→ piece of transparent material

• Convex lens



• Concave lens.

• Convex lens form both virtual and real image
• Concave lens form only virtual image

• 'f' is positive for convex lens and negative for concave lens.

• Human eye is an optical instrument similar to camera.
• Human eye images is formed at retina.
• In camera image is formed at photoplate
• In camera ~~image~~ lens is used.
• Human eye similar to camera b/c the image formed by both is real inverted and small
• Myopia (short sightedness) is corrected by concave lens.
• Hyperopia (long sightedness) is corrected by convex lens
• Compand microscope is used to see objects in laboratories.
• Telescope is used to see distant objects e.g moon
• The magnifying glass is convex lens of short focal length
• d = least distance of distant vision = 25cm $\boxed{M = \left(1 + \frac{d}{f}\right)}$
• Power of lens. $\boxed{P = \frac{1}{f(\text{meter})}}$ unit; diopter (D)

NATURE OF LIGHT & ELECTROMAGNETIC RADIATION

- Light form of energy
- Hypothetical medium ether
- $\Delta E = h\nu$ h = plank's constant, ν = frequency
- photon are energy packets.
- Light posses both particle and wave nature
- The wavelength of red light is greater than that of violet light.
- Sun light consist of seven colours
- A/c to MAXWELL : "Light posses electro magnetic waves"
- Velocity of Electromagnetic waves is equal to that of light.

ELECTRICITY

q_1 = charge on 1st body ; r = distance between the charged bodies.
q_2 = " " 2nd body ;

- Coulomb's Law; → $F = k\frac{q_1 q_2}{r^2}$

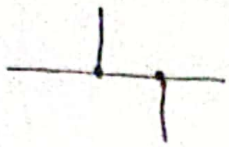
force of attraction or repulsion b/w charges.

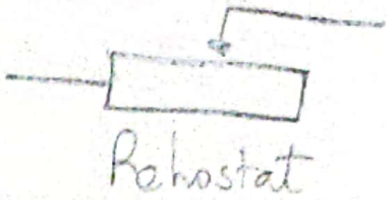
k = coulomb's constant $= 9 \times 10^9 \ N \cdot m^2/C^2$

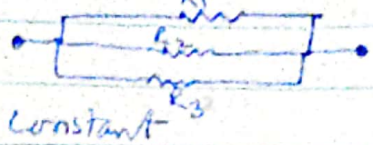
- Repulsion is sure test of electrification
- " " " " magnetism
- Potential difference = $\frac{\text{work done}}{\text{charge}} \Rightarrow \boxed{V = \frac{W}{q}}$
- Capacitance of a capacitor = $\frac{\text{charge}}{\text{volt}} \Rightarrow \boxed{C = \frac{Q}{V}}$
- Current = $\frac{\text{charge}}{\text{Time}} \Rightarrow \boxed{I = \frac{Q}{t}}$
- Ohm's Law ; $\boxed{V = IR}$

Resistance = R

- $\boxed{1 \text{ Volt} = \frac{1 \text{ Joule (J)}}{\text{coulomb (C)}}}$; $\boxed{1 \text{ Farad (F)} = \frac{1 \text{ coulomb (C)}}{\text{Volt}}}$; 1 Ampere = 1 Coul

wires joined 



- 1 Ampere (A) = $\frac{1 \text{ coulomb (C)}}{1 \text{ second (s)}}$ =
- Total resistance (for parallel) 

$$\frac{1}{R_e} = \frac{1}{R_1} + \frac{1}{R_2} + \cdots$$

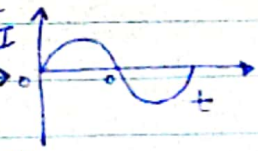
→ Voltage = constant
→ Resistance decrease

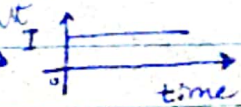
- Total resistance (for series)

$$R_e = R_1 + R_2 \cdots$$

→ current = constant
→ Resistance increases

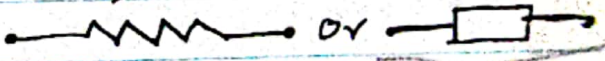
- Power = $\frac{\text{Work}}{\text{time}}$ $\Rightarrow$ $P = \frac{W}{t} = VI = \frac{V^2}{R} = I^2R$
- Commercial unit of electrical energy (KWh) kilowatt hours
- Joule's Law $\longrightarrow$ $W = I^2Rt$

- D.C cannot be change into A.C 

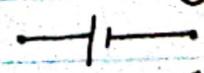
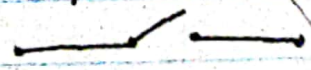
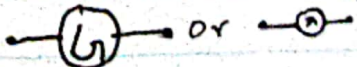
- A.C can be change into D.C 

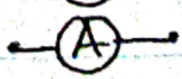
anp. Capacitor → device to store charge
anp. dielectric → insulating medium in capacitor.

✱SYMBOLIC REPRESENTATION.

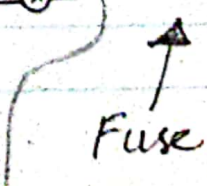
Resistance box →
Resistance → 

Capacitor →
Transformer →
A.C supply →

cell → 
Switch → 
Galvanometer → 

Ammeter → 

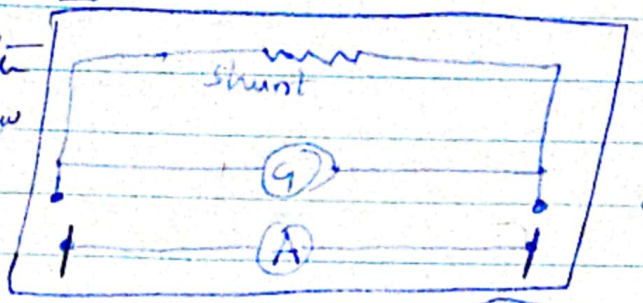
voltmeter →
Reversing key


Fuse

MAGNETISM AND ELECTROMAGNETISM

- Magnetic lines of force start from North pole and ends at South pole.
- Electric motor → device change Electric energy to Mechanical energy.
- Galvanometer → Sensitive instrument measure current.
- Ameter

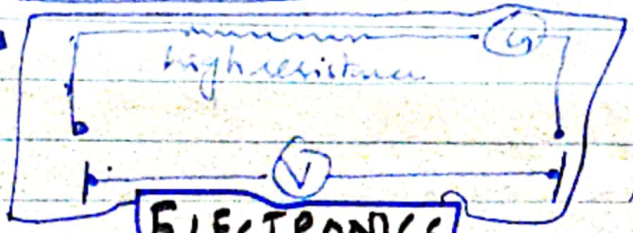
It is galvanometer with a SHUNT (Low resistance in parallel)



It is always connected in series in a circuit.

- Voltmeter

It is galvanometer with a multiplier (high resistance in series)



It is always connected parallel with circuit.

ELECTRONICS

- Electricity → study of flow of charges in conductor.
- Electronics → study of flow of charges in Semiconductor.
- Semiconductor
  - Germanium (Ge)
  - Silicon (Si)

  IV

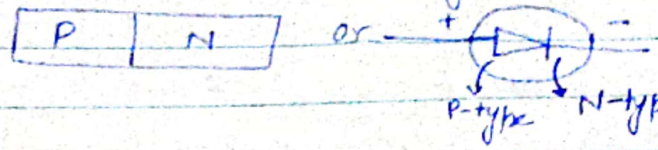
  - Highly pure Silicon and Germanium crystals are almost complete insulators at low temperature
- Having intermediate properties of conductor and insulator
- Addition of impurities called Doping
- IV. (Ge, Si) + III (In) → P-type [acceptor doping]
- IV. (Ge, Si) + V (As) → N-type [donor doping]

- P-type have excess of holes ⊕
- N-type have excess of electrons ⊖

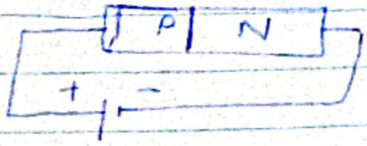
Trivalent = III-A Group elements; E.g Indium(In)
Tetravalent = IV-A Group element; Eg = Silicon(Si)
Pentavalent = V-A Group element; Eg = Arsenic(As)

PN Junction diode:

- Semiconductor diode:

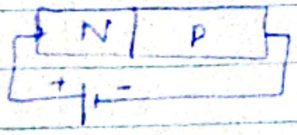


- Forward bais:



output → voltage as conductor.

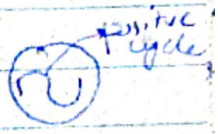
- Reversed bais:



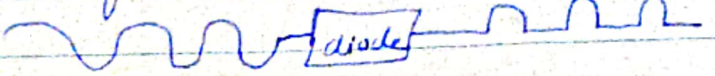
No output insulator

- Rectification.

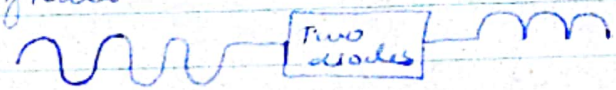
A-C $\xrightarrow{\text{conversion}}$ D.C



- Half wave rectification



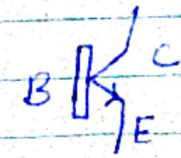
- Full wave rectification



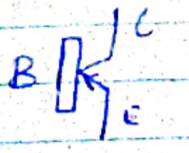
- Transistor

Types of transistor

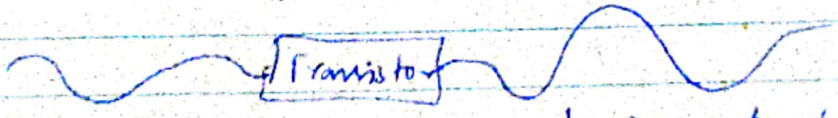
a) N P N — Emitter base collector



b) P N P — E B C



- Transistor as an amplifier



small signals — large output

- Microphone: Sound waves $\xrightarrow{\text{convert}}$ Mechanical waves

- RADAR = Radio Detection and Ranging = microwaves of short wavelength
- Radar for military porpose, air traffic control, detecting the ships and aired planes.
- PN junction behave as rectifier: (A.C → D.C)

NUCLEAR PHYSICS

- Nuclear physics → Study of properties of nucleus and Radiations emitted by it.
- Atomic number (Z) = no of proton
- Mass number (A) = no of proton + no of neutrons
  - A = Z + neutrons

$$\overset{\text{Atomic no}}{\underset{Z}{}}X^{A} \rightarrow \text{Atomic mass (mass number)}$$

(representation)

- Radioactivity → spontenous emission of rays (α, β and γ) e.g. $_{92}U^{235}$, Ra, Po etc
- Elements having (Z) greater than 82 are Radioactive
- Isotopes → Same atomic no but different atomic mass (mass number)
- Lead is better shield against Radiation.
- α-rays → helium nuclei (postive charge)
- β-rays → mass equal to electron (negative charge)
- γ-rays → Electromagnetic waves (neutral charge) not deflected by magnetic field.

- Fission → heavy nuclei is split into light nuclei
- Fusion → Light nuclei fuse into heavy nuclei

Name	Process
Nuclear reactor	→ Fission
Sun	→ Fusion
Atomic/Hydrogen bomb	→ Uncontrolled fission chain reaction

Radio active Isotope	Uses in medicines
• Iodine-131 $[{}_{53}I^{131}]$	for thyroid glands.
• Cobalt-60 $[Co^{60}]$	for severe and deep situated cancer.
• Phosphorous-32 $[P^{32}]$	for treatment of blood cancer Leukemia

- Moderator (Substance used to slow down neutron
- $_{92}U^{235}$ is used as fuel in reactor.

$$_{92}U^{235} + {}_{0}n^{1} \longrightarrow {}_{56}Ba^{144} + {}_{39}Kr^{90} + 3\,{}_{0}n^{1} + \text{Energy}$$

(neutron)

- $E = mc^2$ (mass energy relation)

- It is more difficult to start fusion reaction than fission reaction
- α-rays used for treatment of skin cancer b/c of low penetrating power.
- β-rays are used for treatment of flesh just under the skin b/c penetrating power is moderate.
- γ-rays are used for an infection in the interior of the body because of its high penetrating power.

BASIC CONSTANTS

Name	symbol	Value
speed of light in air	c	3×10^{8} m/s
speed of sound in air	--	340 m/s
speed of sound in vacuum	--	0 m/s
Gravitational constant	G	6.67×10^{-11} Nm^2/kg^2
Gravitational acceleration	g	9.8^{2} m/s^2
Universal gas constant	R	8.31 J/mol·K
Charge on electron	e	1.6×10^{-19} C
Avogadro's number	N_A	6.02×10^{23}/mol
Coulomb's constant	$k=\frac{1}{4\pi\varepsilon_0}$	8.98×10^{9} $N\cdot m^2/C^2$
mass of earth	Me	6×10^{24} kg
Radius of earth	Re	6.4×10^{6} m